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No. 31. MARCH 1886. Vol. VI.

ADDRESS TO THE MINERALOGICAL SOCIETY.

By Professor T. G. Bonney, D.Sc., LL.D., F.R.S., P.G.S., &c.

At the conclusion of my term of office it is a great pleasure to me to be able to congratulate the Society on the condition of its finances. This, three years since, caused some of us no little anxiety ; now, thanks to the efficient management of our Honorary Secretary, we can look forward to the future with confidence.

A slight diminution in the number of our members is, however, to be regretted, as well as some falling off in the number of papers read at the meetings and in the amount of our publications. It would, no doubt, have been easy to have increased the last by the occasional admission into the Journal (as has been done in some of the earlier volumes) of papers which dealt as much with general geology as with mineralogy, but the Council is of opinion that it will prove ultimately more for the real interest of the Society to risk some temporary reduction in the amount published, and even some arrest of its increase in numbers, in order to maintain and strengthen its distinctive character. There are in

Britain many Geological Societies, and many publications devoted to that science, none of which would exclude papers containing mineralogical information. But our own is the only Society which by its title is restricted to the study of mineralogy, and to whose Journal the inquirer would naturally turn for information on that branch of Geognosy. It is a great advantage to a student to know that in a particular Journal he is likely to find the best papers on any special subject, and I believe that we shall do well in the future to secure the high character both of our Journal and of the Mineralogical Society, by avoiding any thing which may look like competition with the publications of Geologists.

Last year I ventured to call your attention to an evil—as it seemed to me—too prevalent among mineralogists, that of distinguishing by new names minerals which either are merely varietal or are in some cases actually indefinite. I again recur to it, because I do not see many signs of a change for the better, and because I am more than ever convinced of the mischief which is being done by this habit of species-splitting to the true progress of mineralogy. There is, perhaps, no one of the Natural Sciences which more than it stands in need of a philosophical treatment, or which has progressed so little beyond a system of classification. In the hands of too many students the notation of difference seems the one thing desired. Numbers of minerals are at present in a worse position than the genus *Rubus*, when more than a hundred species in Britain alone were invented for it by some systematic botanists, for even then there was a genus *Rubus*. Now my complaint is that the idea of *genus* has been only very imperfectly admitted into mineralogy. Yet, as I pointed out last year, this idea, viz. that of relationship, is for purposes of scientific progress of higher value than the idea of species, viz. that of distinction. Inductive reasoning, which is the basis of all science, has far too little scope in mineralogy as ordinarily pursued. Indeed it is hardly too much to say that, were it not for crystallography or crystallology, as it might be more properly called—a department of applied mathematics—mineralogy would be more appropriately named mineralography—that is to say, it could not really claim to rank among the sciences. I do not forget in thus saying that chemistry forms a part of mineralogy, and necessitates processes

of inductive reasoning ; but, as applied to mineral analysis, this reasoning is not of a high order, so that it is possible for a man to be an excellent practical analyst, and yet neither to have acquired the habit nor to possess the capacity of regarding any question in a truly scientific spirit.

The careful notation of differences, whether these be of form, of chemical composition, or of physical characters, is, of course, valuable ; but their co-ordination, with a view of bringing them into systematic relation and of ascertaining in some sense their cause, is far more valuable. In mineralogy the former process is a familiar one, but the latter is at present comparatively strange to us. The science, in fact, still needs its Darwin.

A first step in the development of mineralogy as a science will be made, in my opinion, by following the example of the biological sciences and adopting a binomial nomenclature. It is true, this is done, though timidly and half-heartedly, by the recognition of groups, such as the garnets, the micas, the felspars, the pyroxenes, &c.; but I contend for the admission of this as an accepted principle, and for the use in all scientific writings of the name of the genus (or group) as well as of that of the species. It is, perhaps, immaterial whether we adopt the biological practice (which I should prefer) of placing the generic name first and the specific second, or follow that which custom in mineralogy has to some extent sanctioned, and reverse the order; *i.e.* whether we say garnet-melanite or melanite-garnet, mica-biotite or biotite-mica. It may, perhaps, be urged that every one knows that melanite and essonite are both garnets, biotite and phlogopite both micas ; but relationships among rarer minerals are not so readily learnt and retained, and, in any case, I maintain that a system of nomenclature which deliberately excludes relationships is philosophically unsound.

The investigation of the conditions and limits of the genus in mineralogy, I think, cannot fail to lead to most interesting results. Let us take for example that group of bisilicates of lime, magnesia and iron, of which hornblende and augite are leading forms or species—that which is now sometimes called the pyroxene group. I will attempt to sketch out a few only of the questions which will arise in endeavouring to constitute this as a genus. We shall, I sup-

pose, having in view the fact of pleomorphism, admit that chemical composition rather than crystalline form must be the basis of our definition of genus. In this case, then, probably the first definition of the genus which we should suggest would be "a bisilicate of lime, magnesia and iron, in which usually the first two are dominant over the third;" besides this we should admit as possible variations the presence of alumina, sometimes to a considerable amount, or, more rarely, of a small quantity of an alkali. These last rather important chemical differences would suggest the consideration of whether they were sufficiently associated with other characteristics to make them dominant in any minor grouping of the different species, like sub-generic distinctions—a point on which I will not venture to express an opinion; then would arise the important question whether our genus could be extended to include the minerals, which at the present day are sometimes designated the orthorhombic pyroxenes, such as hypersthene, enstatite, bronzite, &c. As these appear to be almost or wholly free from lime they would perhaps require the establishment of a separate genus. Be this as it may, the investigation of the limits which in this case could be conceded to isomorphic replacement would be full of interest. I should hold that if we found a certain chemical variation always produced a change in the crystalline system we might reasonably consider this as cause for a generic separation. Having, then, fixed the limit of our genus "pyroxene" (or whatever it be called), the question of specific limitation will arise. We should have to investigate the marked differences of habit as regards crystalline form, colour, &c., and to determine how far these were related to differences in composition or differences in environment. I will mention two or three questions which have occurred to myself, as examples of those which we should be led to investigate. Why is the augite in lavas generally almost black in colour, while that in crystalline limestones is green? What is the cause of the extraordinary development of a pinacoidal cleavage in diallage? To what is due the actinolitic habit (as I may call it) in certain varieties of hornblende? Is it always indicative of some kind of metamorphic action? Many like questions will arise—in fact I believe that if any skilled mineralogist would undertake the study of the above group of bisilicates, not in the spirit of the species

maker, but in that of the true man of science, he could not fail to add very largely to our knowledge, and to establish principles which would be capable of wider application. Such investigations as those of Foerstner on felspars from Pantellaria, or of Klein on leucite, noticed in the last number of our Magazine, and the suggestive remarks on the minerals of some of the Scotch peridotites and gabbros, by my friend Prof. Judd, published in the current volume of the Geological Society's Journal, appear to me very hopeful in regard to future progress.

Let me, in conclusion, draw attention to a series of investigations which seem likely to become valuable in obtaining answers to questions similar to those mentioned above, but which, I think, are not very generally known. I refer to the synthetic or artificial production of minerals, which are not unfrequent constituents of the earth's crust. Its importance is obvious, because thus the inferences may be tested which are suggested to us by the study of minerals as they occur in nature.

In some cases mixtures of simpler substance have been operated upon ; in others, crystalline segregation has been induced in the vitreous products of fusion. In both of these processes the result has been obtained, sometimes by elevation of temperature only, sometimes by the joint action of heat, water and pressure.

With these investigations the names of MM. Daubrée, Fouqué and Lévy are more especially connected, and many of the results are described in the *Géologie Experimentale* of the first, and the *Synthèse des Mineraux et des Roches* of the others. In the experiments of the latter, the materials were, in general, fused by the action of heat alone, while M. Daubrée more commonly produced his results in the 'wet way.' It would occupy too much space did I attempt to enumerate the minerals, known to occur in nature, which have been produced artificially; but, confining myself to silicates only, I may mention the following as of special interest, because they enter into the composition of important rock masses : viz. enstatite, varieties of pyroxene, olivine, leucite, nepheline, the principal species of felspars, some species of garnet, biotite, zircon, sphene, besides other minerals less normally present or belonging to other groups, such as wollastonite, apatite, the spinellids, &c.

Some species also of the igneous rocks have been artificially

produced. These are, according to MM. Lévy and Fouqué, andesites and allied rocks; basalts and other rocks of similar chemical composition; nephelinite; leucitite, leucotephrite, and varieties of peridotite. Some of the experiments also were very suggestive in bringing as their result minerals different from those which had been introduced into the original mixture; for example, after fusion, wernerite crystallised as labradorite; a mixture of wernerite and hornblende produced a rock consisting of labradorite and augite; a mixture of oligoclase and hornblende produced an augitic andesite; a mixture of microcline and biotite resulted in a crystalline mass composed of leucite, olivine, melilite and hæmatite, *i.e.* a variety of an olivine-leucitite. Other experiments by their negative results seemed to indicate "that natural rocks composed of quartz, orthoclase, biotite, hornblende," were not formed by a simple process of dry fusion. As might be expected, the time during which a high temperature was maintained and the method of cooling brought about important and suggestive results, upon which, however, I need not now enter. By operating at lower temperatures, in sealed tubes, and in the presence of water, Daubrée converted wood into anthracite, and obtained from an ordinary glass crystallised quartz, diopside and some other silicates. In the latter experiment very remarkable changes were produced in the main mass of the glass itself: parts of it became crowded with microliths, some of pyroxene, some probably of a silicate; while other parts were completely occupied by spherulites, or by tufted masses of elongated microliths of quartz. Similar to these are the results of experiments on the action of dry heat on glasses, at temperatures below their fusing-point. Some of these have been described by myself in another address,* but a more exhaustive investigation is being made by Messrs. Rutley and Herman, the results of which have been in part communicated to the Royal Society. In certain cases, when the glass has been kept for a considerable time at a high temperature, its whole mass appears to have been converted into crystallites; and it is especially interesting to find a close relation between the directions of crystal growth and the form of the substance operated

* To the Geological Society, on Feb. 20th, 1885. See *Quarterly Journal G. S.* Vol. xli

on, indicating the intimate connection of its crystallisation with any thing which disturbs its molecular equilibrium. As I have indicated in the address to which reference has been made above the bearing of these experiments upon the formation of crystalline constituents in rock masses, I will not enlarge upon the subject on the present occasion ; but I mention it because it appears to me a very promising field for investigation. The glasses employed in the arts supply us with substances which vary considerably in chemical composition, and can be procured in quantities which renders the determination of their constituents (often not numerous) comparatively easy. The process of devitrification by dry heat does not require either extremely high temperatures or elaborate and expensive apparatus, while crystals are not seldom obtained of sufficient size and in sufficient abundance to render a determination of the resultant minerals not difficult.

There is then, it seems to me, a great field of work, calling for the exercise not only of patient observation but also of close inductive reasoning, open before the mineralogist. Here one and there another is already pressing forward into it, now from the side of crystallology, now of chemistry, now of petrology ; hence I venture to predict that in the future mineralogy will occupy a far higher rank than it has done of late among the most exact of the natural sciences. I rejoice to think that I am now giving place to one who is so well qualified to act as a leader in this great work, for which I am disqualified by imperfect knowledge, and from which I am diverted by the attraction of other branches of geognosy. Thus, while thanking the members of the Mineralogical Society most heartily for the undeserved honour which they did me in electing me President, and for their continual kindness during my tenure of office, I congratulate them on having obtained as my successor one who is not only so well qualified in other respects, but also is so vastly my superior in the knowledge of their science.

Notes on Minerals from Cornwall and Devon.

By R. H. Solly, F.G.S., Demonstrator in Mineralogy to the University of Cambridge.

Fluor Spar, Holmbush Mine, Callington.

I OBTAINED this summer a most beautiful variety of fluor spar, which was raised from the 145 fathom level of the Holmbush Mine. It is of a transparent azure-blue colour, and shows well marked fluorescent phenomena, though not so strongly as that of Weardale, Cumberland.

Some of the specimens are deep blue in one part and limpid like glass in another; it was found that while the deeply coloured part was strongly fluorescent the limpid part had little or no effect upon the refrangibility of the light passed through it.

The cube planes exhibit well marked rectangular impressions.

Minerals from the Mid-Devon Copper Mine.

There is no record of the minerals to be found at the present time on the burrows of the Mid-Devon Copper Mine, late Belstone Mine, in the parish of Belstone, near Okehampton, and so I thought it would interest the members of the Society if I exhibited and briefly described the minerals I found there this summer.

The mine is situated at the junction of the granite with the millstone grit; the lode, which is of copper pyrites and mispickel, is a flat lode of an ill-defined character, and the ore is richest for copper in the immediate vicinity of the axinite rock. I found the following minerals :—

Garnet, axinite, asbestos, dark green semi-opal, red jasper, copper pyrites, quartz and calcite. The greater portion of these minerals were raised from the 100 fathom level.

Garnet.

This mineral is very abundant, forming large rock masses; some of the crystals are large dodecahedra about $\frac{3}{4}$ of an inch in diameter, of a dull greenish-yellow colour, with very narrow {211} planes.

A few of the crystals exhibit a peculiar structure resembling the mode of growth of the capped quartz crystals from Virtuous Lady Mine, Tavistock. A smaller crystal of a dark-green colour is enveloped by a larger

one more or less altered and lighter coloured, with outer faces parallel to similar faces of the inner crystal. The layer in between the two crystals is soft and brittle, so that the inner crystal can sometimes be removed. Deposited upon the larger crystals are a few smaller dodecahedra of a semi-transparent olive-green colour.

Asbestos.

This mineral is fairly abundant, sometimes verging on actinolite, but more often in tough white masses of the "mountain cork" variety in which the best crystals of axinite are found.

Semi-Opal, Jasper and Hornstone.

I found a few large lumps of dark-green semi-opal, and smaller pieces of red jasper and grey hornstone.

Mispickel.

Some of the crystals of Mispickel are well-defined, with good lustre, elongated in the direction of the *c* axis, and exhibiting the forms *a* {100} *s* {102} *l* {101} *m* {110} *e* {011}.

Copper and Iron Pyrites.

These are met with usually in the massive form mixed together.

Calcite.

In small quantities. Sometimes surrounding the crystals of axinite, whose lustre it has preserved.

Axinite.

Fine large semi-opaque dark-brown crystals of axinite are intimately associated with the garnets; some of the crystals are 1¼ inches long, and one inch broad.

The crystals exhibit the Botallack habit, but are less modified. The planes found are *r* {011} *v* {100} largely developed, narrow *x* {111}, rough *c* {1$\bar{1}$1}, small *p* {010} *z* {012} *l* {120} *u* {110} *s* {121}; the two latter planes are striated parallel to their own intersections. A very common aggregation is met with, of polysynthetic crystals of the above habit grown not quite parallel to the *r* plane. This causes the two parallel *p* planes to be as much as 5° or 10° out of the 180°, and the zone *p v* to be largely developed.

The crystals are elongated in a direction nearly parallel to the normal to the plane *c*.

I give here, as an addendum to the above note, a full account of this very interesting mineral, with the view of facilitating the future work of any other investigator.

Thumerstein was the first name given to axinite by Werner, 1788 (*Bergman Journ.* p. 55 and p. 262), from Thum, in Saxony, where it was found. Previous to this date this mineral had been known only as a variety of schorl.

In 1791 Delamethérie called it yanolite (violet stone), but it was not until 1822 that Haüy published the first crystallographic account of this mineral, which he had previously called axinite.

Literature (*Crystallographic*).

Haüy,	1822.	Traité de Mineralogie, III. p. 22.
Haüy,	1822.	Traité de Crystallographié, p. 37.
Phillips,	1823.	Elementary Introduc. Mineral. p. 43.
Neumann,	1825.	Poggendorf's Annalen IV. p. 63.
Kupffer,	1826.	Pogg. Ann. Bd. VIII. p. 228.
Levy,	1837.	Descr. d'une Coll. de Min., Vol. II. p. 107.
Brooke & Miller,	1852.	Mineralogy, p. 348.
Des Cloizeaux,	1862.	Manuel de Minéralogie, p. 515.
Hessenberg,	1863.	Mineralogische Notizen, No. V. p. 27.
Vom Rath,	1866.	Poggendorff's Annalen, CXXVIII. pp. 20, 227.
Schrauf,	1870.	Sitzungsberichte der k.k. Akad. Wiss. LXII. Abth. p. 712.
Websky,	1872.	Min. Mitth. Tschermak, Heft. I. p. 1.
Hessenberg,	1873.	Mineralogische Notizen, No. XI. p. 30.
Frazier,	1882.	The American Journal of Science. Vol. XXIV. p. 439.

(*Physical and Chemical*).

Rose and Riess,		Schriften Akad. Berlin. LIX. p. 375.
Rammelsberg,	1875.	Handbuch der Mineralchemie, p. 544.

The above list includes all publications relating to axinite which contain original crystallographic, physical and chemical work.

The names of many other works are omitted, which only contain information compiled from earlier sources, or which merely mention a new locality where this mineral has been found.

The four most important and comprehensive works are those by Neumann, Des Cloizeaux, Vom Rath and Schrauf.

The valuable work by Phillips in 1823, with record of six new planes and five doubtful or vicinal faces, is entirely ignored by Neumann, who does not quote his work, and even Miller, in 1852, also omits the face

		Haüy.	Phillips.	Neumann.	Miller.	Des Cloiz.	Vom Rath.	Schrauf.	Discoverer.
v	100	*T*	*K*	*v*	*v*	g_1	*v*	*M*	Haüy.
p	010	*P*	*M*	*P*	*p*	*m*	*P*	*c*	,,
m	001	*M*	f_3	*M*	*m*	c_1	*m*	*m*	,,
x	111	*x*	d_1	*x*	*x*	i_1	*x*	*x*	,,
c	$1\bar{1}1$			*c*	*c*	*z*	*c*	*Y*	Neumann.
n	$11\bar{1}$	*n*	*c*	*n*	*n*	e_1	*n*	*n*	Haüy.
q	$2\bar{1}1$			*m*	*q*	δ	*q*	*q*	Neumann.
s	121	*s*	*h*	*s*	*s*	*s*	*s*	*s*	Haüy.
σ	$12\bar{1}$							σ	Schrauf.
d	$\bar{1}2\bar{1}$						*d*	*d*	Vom Rath.
o	$1\bar{1}2$		d_3	*o*	*o*	*x*	*o*	*o*	Phillips.
δ	$1\bar{1}\bar{2}$						δ	δ	Vom Rath.
i	131		a_2	σ	*i*	o_1	*i*	*i*	Phillips.
ψ	$1\bar{1}3$							ψ	Schrauf.
k	$2\bar{2}1$						*k*	*k*	Vom Rath.
u	110	*u*	*T*	*u*	*u*	*t*	*u*	*u*	Haüy.
w	$1\bar{1}0$		*k'*	*w*	*w*	g_2	*w*	*w*	Phillips.
h^2_2	9 11 0					h^2_2	h^2_2	*K*	Des Cloizeaux.
a	340						*a*	*a*	Vom Rath.
h_2	230					h_2	h_2	*H*	Des Cloizeaux.
β	350						β	β	Vom Rath.
l	120	*l*		*l*	*l*	*h'*	*l*	*l*	Haüy.
h	130						*h*	*h*	Vom Rath.
y	101		d_2	*y*	*y*	γ	*y*	*a*	Phillips.
b	$10\bar{1}$						*b*	*b*	Vom Rath.
μ	$20\bar{1}$								Hessenberg.
f	102					β	*f*	*f*	Des Cloizeaux.
g	103						*g*	*g*	Vom Rath.
r	011	*r*	*P*	*r*	*r*	*p*	*r*	*r*	Haüy.
e	$01\bar{1}$		f_2	r_1	*e*	$c\frac{1}{2}$	*e*	*e*	Phillips.
ϕ	031								Hessenberg.
π	021							π	Schrauf.
c_5	045		*f'*			e_5		*L*	Phillips.
z	012	*z*			*z*	e_2	*z*	*z*	Haüy.
t	$23\bar{1}$						*t*	*t*	Vom Rath.
ϵ	$1\bar{3}2$								Websky.
ρ	$23\bar{1}$								Schrauf.
η	13 $\bar{4}6$ $\bar{1}1$						η	η	Vom Rath.
θ	$31\bar{2}$						θ	θ	,,
ζ	$21\bar{5}$						ζ	ζ	,,
ξ	$16\bar{3}$							ξ	Schrauf.
τ	$18\bar{3}$							τ	,,

{045}, merely reproducing in his Mineralogy (Brooke and Miller) Neumann's results in Millerian symbols. The plane f {045}, discovered by Phillips, omitted by Neumann, reproduced by Des Cloizeaux as c_5, again omitted by Vom Rath, but reinstated by Schrauf as L, is present on some of the crystals in the Cambridge Collection.

The number of definite forms at present observed on axinite are 42—

Haüy	discovered	10
Phillips	,,	6
Neumann	,,	2
Des Cloizeaux	,,	3
Vom Rath	,,	12
Schrauf	,,	6
Websky	,,	1
Hessenberg	,,	2
		42

The table on p. 205 gives a complete list of the 42 forms at present established, with the names of their first observers and the letters employed to designate the planes by Haüy, Phillips, Neumann, Miller, Des Cloizeaux, Vom Rath and Schrauf. The form ν {211}, given by Frazier, is omitted, as it is undoubtedly a mistake.

Doubtful Faces.

The following measurements were obtained by Phillips from the five vicinal or doubtful faces, i_1, i_2, i_4, i_5 in zone pu:—

$$\begin{cases} pi_1 = 0°40' \\ pi_2 = 5°20' \\ pi_4 = 37°32' \\ pi_5 = 41°50' \end{cases}$$

Also a_1 1° from p and 46°35′ from r.

Hessenberg, page 28 *Mineral. Not.* V. 1863, describes a doubtful face he calls β (056) on a crystal from Scopi.

Vom Rath, on p. 250 of his Memoir, describes a dull face on a crystal from Botallack, which he calls λ, lying between w and q, and probably truncating the edge between them.

Websky describes five doubtful or vicinal faces lying between p and r-viz. π_a, π_β, π_γ, π_δ, π_ϵ, on crystals from Striegau, in Silesia.

$$\begin{cases} r\ \pi_a = 20°46' \\ r\ \pi_\beta = 19°25' \\ r\ \pi_\gamma = 10°21' \\ r\ \pi_\delta = 4°53' \\ r\ \pi_\epsilon = 4°9' \end{cases}$$

Elements.

It has appeared best for the practical value of this paper to choose such elements as most nearly approach the mean values of measurements obtained from crystals from different localities, instead of giving different elements for different localities; and these seem to be best obtained from the theoretical angles calculated by Vom Rath. Miller's elements have therefore been discarded, but his mode of projection and the faces he chose for his 100, 010, 001, 111 planes have been retained (see Fig. 1, Pl. V.). Schrauf, desiring to contrast axinite with sphene, has chosen different values for his elements and different axial planes, also a different position for his crystal, but since they agree less closely with the mean values found by other observers, and depict less clearly the habit of the crystal, they have not been adopted. He makes a mistake in his stereographic projection in the zone *Mc*. He places the planes $l, h_2, h^2_{\frac{1}{2}}, \beta, a, v$, in this order instead of $l, \beta, h_2, a, h^2_{\frac{1}{2}}, u$; and also transforms Vom Rath's indices of the plane $h^2_{\frac{1}{2}}$ into 779 instead of 14 14 7.

011 : 010 = 45°15′
001 : 011 = 44°40½′
101 : 001 = 56°58′
100 : 101 = 40°52′
100 : 010 = 77°15½′

Combinations.

The following is a list of the faces which have been found on crystals from the undermentioned localities. The usual prominent faces are printed in thicker type.

Botallack.—p ϕ **r** z **m**, l u v w, s **x** y c, g μ b, o n, d. (Vom Rath, Fig. 17.) See Fig. 3, Pl. V.

Belstone.—**p r** x, l o v, s, c.

Dauphiné.—e **p r** z **m**, l β $h^2_{\frac{1}{2}}$ u a v w, i **s** x y, f, o, g, k, d, ξ, t. (Vom Rath, Fig. 18.) See Fig. 4, Pl. V.

Baveno, and Oisans.—**p r**, l **u** v x n. (Strüver.)

Santa Maria.—**p r**, **u** v w, s x **y**, o.

Striegau.—**p** π **r** m, l u w, s **x**, f. (Websky, Fig. 3B.) See Fig. 8, Pl. V.

Scopi.—**p r** m, β **u** v **w**, s x **y**, t, n. (Hessenberg.)

Hartz.—**p r**, **l u** v, **s x**, c.

Poloma.—e **p** ϕ **r** z m, **l u** v w, s y c σ, o n, ρ, t, d. (Schrauf, Fig. 19.) See Fig. 6, Pl. V.

Lake Onega.—e **p** π **r** m, h l **u** v, s x y, ξ, τ. (Schrauf, Fig. 20.) See Fig. 7, Pl. V.

Nordmarken.—**p r** m, **l** a, s y, f, g.

Filipstad, Wermland.—**p r** m, **s u**.

Kongsberg.—p *r z m*, *l* u *v*, *s x y*, *o*, *n d*. (Vom Rath.)
Pyrenees.—p *r*, l u *v*, *s x*. (Schrauf.)
Bethlehem.—*e* p ϕ r s *m*, *l u v* w, s *x y c* σ, *d m b*, δ *o*. (Frazier, Fig. 2.)
See Fig. 5, Pl. V.

The following is a list of calculated angles :—

ep	=	45°19′	*pi*	=	24°33′	*ry*	=	58°45′	*mg*	=	24°12′
pϕ	=	18°36′	*is*	=	8°45′	*yq*	=	27°39′	*gf*	=	10°37′
$\phi\pi$	=	8°11′	*sx*	=	16°7′	*qw*	=	29°18′	*fy*	=	22°9′
πr	=	18°27′	*xy*	=	29°48′	*wt*	=	20°1′	*yv*	=	40°52′
rc$_5$	=	6°19′	*yc*	=	36°11′	*td*	=	11°46′	*v*μ	=	20°9′
c$_5$ s	=	12°2′	*c*σ	=	23°27′	*d*ε	=	22°5′	μb	=	14°48′
zm	=	26°21′	$\sigma p'$	=	41°9′	$\varepsilon r'$	=	10°26′	*bm*′	=	47°13′
me′	=	44°45′									
eh	=	46°13′	*pf*	=	82°31′	*rf*	=	47°40′	$m\psi$	=	26°47′
hs	=	22°	*fo*	=	25°6′	*fc*	=	39°14′	ψo	=	11°13′
sg	=	57°29′	*op*′	=	72°16′	*c*ρ	=	23°37′	*oc*	=	21°57′
ge′	=	54°18′				$\rho r'$	=	69°29	*cw*	=	37°5′
									wk	=	18°20′
el	=	48°25′	ϕs	=	30°58′				*kn*	=	14°9′
lx	=	32°30′	*sw*	=	86°48′				$n\delta$	=	13°48′
xf	=	38°40′	$w\eta$	=	39°28′	*rg*	=	44°32′	$\delta m'$	=	36°41′
fζ	=	13°23′	$\eta\phi'$	=	22°46′	*go*	=	25°16′			
$\zeta\psi$	=	9°3′				*o*σ	=	35°52′			
$\psi e'$	=	37°59′				$\sigma\xi$	=	55°9′	$m\sigma$	=	68°36′
			πi	=	39°52′	$\xi r'$	=	19°11′	$\sigma\delta$	=	50°40′
eu	=	55°9′	*iu*	=	19°44′				$\delta m'$	=	60°44′
uy	=	49°40′	$u\mu$	=	37°17′						
yo	=	35°58′	μn	=	38°6′	*zs*	=	49°52′			
oe′	=	39°13′	$n\varepsilon$	=	28°2′	*sh*$_2$	=	23°14′	*bc*	=	97°19′
			$\epsilon\pi'$	=	22°59′	h_2z'	=	106°54′	*bo*	=	78°18′
ev	=	75°24′							*bk*	=	38°49′
vq	=	31°39′							βo	=	22°26′
qc	=	24°6′	πs	=	27°34′	sx	=	48°11′	*cu*	=	80°26′
ce′	=	48°51′	*sv*	=	54°17′	*xb*	=	74°15′	δv	=	58°51′
			vk	=	44°45′	*bz*′	=	57°34′	ηn	=	41°3′
eb	=	53°9′	*kd*	=	21°13′				ηs	=	132°40′
$b\theta$	=	14°33′	$d\xi$	=	10°51′				ηv	=	80°2′
θw	=	37°12′	$\xi\pi'$	=	21°20′	*zv*	=	88°36′	ηx	=	119°
$w\rho$	=	22°48′				$v\theta$	=	27°39′	*fs*	=	52°19′
$\rho\sigma$	=	14°15′				$\theta\delta$	=	30°32′	*fz*	=	37°36′
$\sigma e'$	=	37°54′	πx	=	39°35′	$\delta z'$	=	33°13′	*gp*	=	84°42′
			xw	=	80°9′				*gw*	=	79°12′
pb	=	80°39′	$w\pi'$	=	60°20′				*gx*	=	45°50′
bn	=	31°55′				*zy*	=	55°9′	*lz*	=	70°49′
nd	=	22°19′				*gn*	=	82°36′	*nq*	=	57°10′
dp′	=	45°7′				*nz*′	=	42°15′	*ns*	=	77°58′
			ri	=	36°29′				*os*	=	76°43′
pμ	=	78°40′	*il*	=	18°54′				*ov*	=	70°3′
μk	=	38°	*lr*′	=	124°37′				*ox*	=	61°51′
kt	=	13°49′				*zg*	=	30°54′	*oz*	=	55°12′
tp′	=	49°31′				*gc*	=	44°8′	*qs*	=	67°56′
						cd	=	63°37′	*qx*	=	52°58′
ph	=	21°1′	*rs*	=	36°25′	*dz*′	=	41°21′	*st*	=	69°35′
hl	=	7°54′	*su*	=	27°57′				τp	=	23°59′
$l\beta$	=	3°58′	*ub*	=	47°14′				τr	=	24°9′
βh_2	=	2°23′	$b\delta$	=	30°13′	*ms*	=	72°12′	τy	=	75°10′
h_2a	=	2°41′	$\delta r'$	=	38°11′	*sl*	=	21°37′	ξu	=	64°27′
ah_2^s	=	2°8′				*lm*′	=	86°11′	ξb	=	75°38′
$h_2^s u$	=	4°24′	*rx*	=	40°47′				μq	=	47°46′
uv	=	32°47′	*xv*	=	45°53′	*mx*	=	65°1′	μr	=	101°15′
vw	=	42°15′	*vn*	=	49°32′	*xu*	=	30°33′			
wp′	=	60°29′	*nr*′	=	43°48′	*um*′	=	84°26′			

The faces in the zone *pv* are often deeply striated parallel to the intersection of *l* and *u*. The faces in the zone *pz* are channelled and striated parallel to the intersections of the planes *p* and *r*. The face *p* often bears crossed striations at an angle of 77°3′ and parallel to the edge *rx* and *xn*. All the faces are more or less rounded.

The face *c* is often dull, and *v* is sometimes rough. The crystals from Botallack and Belstone are grown nearly parallel to the plane *r*, and generally elongated in the direction of the normal to *c*.

Cleavage; *m*, *v* and *w* fair, *r* indistinct and interrupted, traces along *p* and *y*. Fracture; conchoidal to uneven. Brittle. Transparent to translucent on the edges. Lustre; highly vitreous.

Colour; clove-brown of various shades, inclining to plum-blue to pearl grey. It exhibits trichroism. On looking through a crystal in the direction of either optic axis, a dark violet stripe is seen, interrupted at the point occupied by the axis (Miller).

The acute bisectrix is negative, and normal to the plane *x*. The planes of the red and the green axes appear to be orientated nearly identically like those of the mean. The dispersion, scarcely perceptible in oil, is on the contrary very strong in air. $\rho < \nu$.

$2H$ ranges between 82°15′ and 84°50′

$2E$ „ „ 148°53′ and 172°10′

(Des Cloizeaux.)

Hardness; 6·5 to 7. S. G.; 3·29 to 3·30. Crystals from Oisans, analysed by Rammelsberg before calcination, had a density of 3·295, which was reduced after fusion to 2·812. Acquires vitreous electricity by friction. Pyro-electric, the faces *n* contain the antilogous poles and the angles *uxp* and *u′ x′ p′* the analogous poles (Riess and G. Rose). (See Fig. 2, Pl. V.)

Before the blowpipe intumesces and fuses easily to a dark-green glass. With fluor spar and bi-sulphate of potash imparts a green colour to the flame. Hardly acted on by acids. After fusion gelatinises with H Cl.

The following analyses and remarks on the chemical composition are by Rammelsberg—

1. Oisans, Dauphiné.
2. Treseburg, Harz.
3. Berkutzkaja Gora, near Miask.

	1.			3.
	a.	*b.*		
Silica	44·57	43·46	43·73	43·72
Boracic Acid	4·50	5·61	—	—
Alumina	16·37	16·33	15·66	16·92
Sesquiox. of Iron	9·67	2·80	11·94	10·21
Protox. of Iron	—	6·78	—	—
Protox. of Mangan.	2·62	2·62	1·37	1·16
Lime	20·19	20·19	18·90	19·96
Magnesia	1·73	1·73	1·77	2·21
Potash	0·11	0·11	—	—
Water	—	1·45	—	—
	99·76	101·08	94·18	93·37

Rammelsberg considers the water present as water of constitution.

Nos. 2 and 3 have not been examined with regard to the protoxide of iron and the water.

In 1 b :—

$$H, K : \overset{II.}{R} : (R_2) : (B_2) : Si \quad \text{or} \quad \overset{I.}{R} : \overset{II.}{R} : (R_2) : Si$$

$$1 : 3 : 1 : 0{\cdot}45 : 4{\cdot}1 \qquad 1 : 3 : 1{\cdot}45 : 4{\cdot}1$$

that is to say— $1 : 3 : 1{\cdot}5 : 4.$

If one assumes that axinite in reality contains nearly 2 per cent. of water (its determination being very difficult on account of the contemporaneous change of the protoxide of iron into sesquioxide), it is a uni-silicate.

$$\overset{I.}{R_2}\ \overset{II.}{R_6}\ (R_2)_3\ Si_8\ O_{32}$$

in which $\overset{I.}{R}$ contains very little K; $\overset{II.}{R}$ = Mg, Mn, 2 Fe, 8 Ca; $(R_2) = (B_2)$ and 2 (Al_2).

The calculated quantity of boracic acid is 6 per cent. (Rammelsberg.)

Axinite occurs in attached crystals or small masses, sometimes fibrous, usually in veins or beds in granite, gneiss, mica and hornblende schists, clay-slate, diorite and diabase. Commonly associated with quartz, albite, orthoclase, epidote, garnet, asbestos, prehnite, tourmaline, &c.

Localities.

England—*Cornwall.*—In dark clove-brown crystals, sometimes 1½ inches across, at Botallack Rocks, Roscommon Cliff, Trewellard Cliffs, and Wheal Cock, St. Just; in granite associated with asbestos, epidote, garnet and apatite.

In light grey violet crystals at Boscawen Cliffs, St. Buryan and Lamorna Cove, with epidote, quartz and schorl.

Also at Carharrack, St. Day; Camborne Vean, Camborne; St. Columb;

Trevascus Mine, Gwinear; Wheal Crofty, East Illogan; Lizard; Marazion, Penzance, and in indurated clay-slate at Lostwithiel.

Devonshire.—In dark clove-brown crystals similar to the Botallack ones at Mid-Devon Consols Mine, Belstone, with asbestos, garnet and calcite, also at Sticklepath, Okehampton, Brent Tor, Tavistock.

France.—Most beautiful crystals of a translucent violet-brown colour, sometimes 2 inches across, from Saint Christophe, Oisans, Département de l'Isère, associated with albite, prehnite, quartz and chlorite; at Montanvert, Savoy, and also *Italy*, Baveno.

Switzerland.—At Berg Sella, Saint Gothard; and also at Scopi, near Santa-Maria, Medelser Thal, the Cantons Grisons and Uri.

Germany.—Saxony, Thum, near Ehrenfriedersdorf, with mispickel, blende, pyrrhotine and quartz, also at Schneeberg, Schwarzenberg, Grünstädtel.

In well-developed crystals, from 2 to 10 mm. across, on orthoclase with albite, epidote, quartz and stilbite at Striegau, Silesia, (Websky), *Hartz*, near Heinrichsburg in Selkethal, Falkenstein, Taunus, Treseburg, Bodethal; with asbestos and prehnite, Wormke, near Schierke; with prehnite on greenstone, Samson Mine, Andreasberg.

In small violet-blue crystals with harmotome and epidote at Bergmannstrots.

Austria.—In dark-brown opaque crystals not strongly lustrous, with calcite, apatite, gold, copper pyrites and malachite, on green hornblende schist, at Poloma, near Betler, Hungary (Schrauf), and at Wallamühle, near Röschitz, Moravia; and Gömörer, Hungary; Monzoni, Tyrol.

Russia.—In dark reddish-brown crystals (habit between that of Botallack and Poloma), in amygdaloidal cavities, on Wolf Island, Onega Lake; also at Berkutzkaja Gora, near Miask, Urals.

Sweden.—Similar to Dauphiné crystals with yellow garnet and idocrase at Phipsburg; also with magnetic iron at Nordmark, and Grundsjö Mine, near Filipstad, Wermland.

Norway.—Small crystals with black mica, quartz and native silver in a white laminated calcareous rock, at King Louis Mine, Kongsberg; also with felspar and epidote at Arendal.

Spain.—Upon a gangue of quartz at Mount Ereslids, near Baréges, Pyrenees, and also at Arbizon, Hautes Pyrenees.

United States.—In small colourless to pale brown crystals, sometimes highly brilliant, with asbestos and hornblende, near Bethlehem, Northampton County, Pennsylvania (Frazier); also at Wales, Maine; and Cold Spring, New York.

South America.—With smaltine and grey cobalt at La Bintre Mine, Coquimbo, Chili.

Note on Dr. Mackenzie's Paper read at the June Meeting.

The attention of the Editing Committee having been called to the apparent identity of a paper by Dr. G. S. Mackenzie "On an Occurrence of rare Minerals from Utah," with one by Dr. Hillebrand "On an Association of rare Minerals from Utah," the Committee have communicated with Dr. Mackenzie, and have received from him the following letter:—

Craig Lee, near Dundee,
28th November, 1885.

Dear Sir,

In view of the appearance of an article by me in the August number of this Journal entitled "On an Occurrence of rare Minerals from Utah," I beg to state that the credit of the investigation of these minerals is due to Dr. Hillebrand and Mr. Whitman Cross, of the U.S. Geological Survey, Denver, Colo., and, although I have made independent determinations of several of the constituents of these minerals subsequently to them, I exceedingly regret the appearance of the paper in print without due notice having been taken and prominence given to the papers of Dr. Hillebrand and Mr. Cross on this subject in the "Proceedings of the Colorado Scientific Society."

I am, &c.,
(Signed) George S. Mackenzie.

R. H. Scott, Esq.,
Secretary of the Mineralogical Society.

Some Results of the Crystallographic Study of Danburite.

By Dr. Max Schuster, of Vienna.

[Communicated by the President.]
[Read October 20th.]

EVERY student of crystals is aware how frequently they fall short of the ideal perfection which theory ascribes to them. With regard to the development of the simple forms, the irregularities are most prominent on the crystals which are subject to certain laws of symmetry. In consequence of the differences of size presented on the same crystal by planes belonging to the same form, the most manifold distortions ensue, resulting at one time in the imitation of forms of a lower degree of symmetry, at another in the complete absence of symmetry. Moreover, as long as the faces constituting the distorted form remain the same, *i.e.* as long as the cause of the distortion is without influence on the development of the combination, so long will the angles of inclination of the circumscribing elements of the individual remain the same, and thus the degree of symmetry can be determined by measurement of the crystal notwithstanding the distortion. This is generally the case, and is characterised as the constancy of the angles of inclination. Exceptions to this law will be alluded to further on.

The physical state of the faces themselves may cause great difficulty in the exact determination of the angles of inclination, for the faces are rarely plane and smooth, being as a rule either curved, or plane but dull, or finally, even when good reflectors, are reticulated or broken up into a number of distinct fields. Unorganised bodies naturally bounded by curved faces can scarcely lay claim to the designation of crystals, but are rather, at most, to be characterised as crystalline individuals, when endowed with a definite homogeneous internal structure. On crystals with plane but dull faces, one may conceive that the outermost molecules of the planes which constitute the boundary surface are homogeneously distributed, though they are not present in sufficient number to correspond with the internal network. Finally, when the faces of a crystal are smooth and bright, but appear broken up into several fields, the following cases may be distinguished: — either the molecules in the different fields are differently arranged towards one another — a point which a simple optical

examination will decide—and the crystal is then only apparently homogeneous, but is in reality a group built up of subordinate individuals in almost parallel position, or in twinned juxtaposition, a case that occurs more frequently in mimetic crystals. Or, again, it is found that all the fields can be referred as bounding elements to one and the same crystallographic individual.

It appears to be an essential character of crystals that they are bounded by a limited number of faces which are parallel to internal molecular planes, more particularly to such planes as may be said to possess the greatest molecular density ; the occurrence, therefore, of faces with highly complex indices strikes the observer as being abnormal, and the question arises whether such faces are subject to the same laws, and are as characteristic of the substance on which they occur, as the simple typical faces which they replace.

Whilst engaged upon the crystallographic investigation of the mineral danburite, recently found at Mount Scopi, in Switzerland, the author was in a position to study such elementary planes very completely, and with some unexpected results, which have been given in detail in a paper published elsewhere.*

Among the faces with complex indices, in addition to those which appear as occasional and local developments, and which, as a rule, belong to that class of secondary planes known as "vicinal" planes, others were observed which are characterised by the peculiarity that they almost coincide with the simple typical faces in conjunction with which they are found; so much so, that the inclination frequently amounts to only a few minutes of arc. These faces have a real and probably a genetic relationship to the principal faces.

At present it is desired to draw attention to two of the most marked characteristics of these planes, for which the designation of "transitional faces" has been proposed.

That these planes are genuine, although they often almost defy detection and observation, is proved by the fact that they in the great majority of cases lie in zones well defined by typical planes, and that they occupy in these zones definite positions recurring in many different crystals; further, they frequently appear in exactly the number and distribution corresponding with the symmetrical disposition of those primary faces to which they stand in the relation of vicinal planes.

These faces are, however, in their occurrence much more variable than

* *Tschermak's mineralogische und petrographische Mittheilungen*, Vol. V. p. 397, and Vol. VI. p. 301.

are the faces with simpler indices; and it is a remarkable fact that they are much more susceptible to the influences which give rise to distortion. Whilst planes with simple indices are either diminished or increased in size by distortion, without being actually obliterated, it frequently happens that under such circumstances existing "transitional faces" are replaced by new ones, of which the disposition may be proved to correspond with the irregular development of the form.

This fact may become exceedingly valuable for the study of the phenomena of crystal-growth, for it affords a means of recognising, not only the exact part of the growing crystal where a disturbance in the uniform development commenced, but also of gaining a clue to the measurable amount of the divergence.

More remarkable yet are the numerical relations between the indices of the various transitional planes and the corresponding simple faces. Such relations are the simplest in the case of pinakoids, and can be briefly expressed thus: the intercepts of the vicinal faces on the axes lying in any pinakoid appear as multiples of a definite factor (which is the same for all the parametral axes) in such a manner that all the indices of the transitional faces in question would be simple, if only the factor were made equal to unity.

It was fully demonstrated in the paper quoted above, that the same factor is similarly related to the indices of transitional faces which appear in conjunction with prismatic and pyramidal faces, though the relationship cannot be expressed so simply as above. As this factor is the same for all the principal planes, without exception, we are led to infer that it represents a particular state of the fluid which surrounded the crystal during the growth of the vicinal faces.

The further circumstance that such planes of highly complex indices resolve into those of simple indices upon the elimination of this factor, seems to indicate that such simple planes at any rate tend to be present.

It would appear, therefore, that the transitional faces, in the case of danburite, spring from the same cause as the inequality in the development of faces of a form. They would thus have to be regarded as the result of the action of two sets of forces; one acting in connection with the arrival of newly deposited molecules and their state, the other emanating from and connected with the so far completed faces of the crystal; in other words, these planes are induced by the tendency towards the formation of a new plane over one already completed.

It would be out of place to enter further, on this occasion, upon the subject of the paper already quoted, viz. the deduction, discussion, and

closer confirmation of the above theorems, and the theoretical and practical results which would seem to accrue for the crystallographer. The object of this note will have been fulfilled if the author has succeeded in attracting the attention of students to these remarkable elementary faces, and has convinced them that the study of such subordinate features is not as hopeless as might at first sight appear; but that a prospect is opened up that these complicated features (which to a German *savant* seemed so wonderful that he compared them with those of the living plant) may yet be made amenable to mathematical laws which doubtless underlie them.

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MARGARITE. W. Clarke and T. Chatard. Am. J. Sc. xxviii. p. 22. *Chem*

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MARIALITE. G. Tschermak. Ber. Ak. Wien. lxxxviii. (1). p. 1142. *Min.*

MARMATITE. J. Bruce. Chem. News, l. p. 220. *Freiberg. Chem.*

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MELONITE. W. Hillebrand. Proc. Col. Sc. Soc. i. p. 123. *Colorado.*

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H. Miers. Min Mag. v. p. 325. *Cryst.*
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MENILITE. A. Damour. Bull. Soc Min. vii. p. 239 *Chem.*

METALLIFEROUS DEPOSITS. C Ochsenius. Geol. Mag. i. p. 310.

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I. Eastman. Am. J. Sc. xxviii. p. 299. *Michigan.*

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MILLERITE. A. Leonhard. Trans. Ac. St. L. iv. p. 493. *St. Louis.*

MINERALS. J. Thoulet. Bull. Soc. Min. vii. p. 151. *Expansion of.*
C. Hintze. Chem. Cent. Bl. xv. p. 657. *Isomorphism of.*
T. Carnelly. Min. Mag. vi. p. 83. *Periodic Law in.*
C. Rammelsberg. N. J. (2), p. 67. *Isomorphous.*
L. Bombicci. Mem. Ac. Bol. v. p. 3. *Polygenesis and Isomorphism.*
M. Lévy. Bull. Soc. Min. vii. p. 43. *Opt.*

MISENITE. G. Wyrouboff. Bull. Soc. Min. vii. p. 5. *Cryst.*

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W. Hillebrand. Am. J. Sc. xxvii. p. 355. *Sulphobismuthite of Copper and Silver;* and Proc. Col. Sc. Soc. i. p. 53.

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B. Kosmann. Jahresb. Schles. Ges. 1883, p. 145. *Min.;* and B. H. Ztg. xliii. pp. 198, 209.

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A. Lacroix. Bull. Soc. Min. vii. p. 172. *Ile Bourbon.*
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A. Descloizeaux. Bull. Soc. Min. vii. p. 135. *Opt.*
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LIST OF ABBREVIATIONS USED IN INDEX.

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An. Soc. Esp. Hist. Nat.	Anales de la Sociedad Española di Historia Natural. Madrid.
An. Soc. Arg.	Anales Sociedad Cientifica Argentine. Beunas Aires.
Ann. Soc. Agr. Lyon.	Annales de la Société d'Agriculture, Histoire naturelle, et Arts utiles. Lyon.
Ann. Soc. Linn. Lyon.	Annales de la Société Linnéene. Lyon.
Arch. Mus. Rio Jan.	Archives do Museo Nacional do Rio de Janeiro. Rio de Janeiro.
Beit. Kennt. Russ. Reich.	Beiträge zür Kenntniss des Russischen Reiches und der Angrenzenden Länder Asiens. St. Petersburg.
Bibl. Ec. H. Et.	Bibliothèque de l'Ecole des Hautes Etudes. Paris.
Boll. Com. Geol.	Bolletino del R. Comitato Geologico d' Italia. Roma.
Bomb. R. As. Soc.	Bombay Branch of the Royal Asiatic Society. Bombay.
Bull. Am. Mus.	Bulletin of the American Museum of Natural History. New York.
Bull. Buff. Soc.	Bulletin of the Buffalo Society of Natural History. Buffalo.
Bull. Ess. Inst.	Bulletin of the Essex Institute. Salem, Mass.
Bull. Soc. Nancy.	Bulletin de la Société des Sciences de Nancy. Nancy.
Bull. Soc. Norm.	Bulletin de la Société Linnéene de Normandie. Caen.
Bull. Soc. Philom.	Bulletin de la Société Philomathique de Paris. Paris.
Bull. Soc. Toul.	Bulletin de la Société de Histoire Naturelle de Toulouse. Toulouse.
Jahresb. Schles. Ges.	Jahresbericht der Schlesischen Gesellschaft für vaterländische Cultur. Breslau.
Jahrb. Karp. Ver.	Jahrbuch des Siebenbürgischen Karpathen-Vereins. Hermannstadt.
J. Soc. Cinc.	Journal of the Cincinnati Society of Natural History. Cincinnati.
Korrbl. Ver. Riga.	Korrespondenzblatt des Naturforscher Vereins zu Riga. Riga.
Mem. Ac. Bost.	Memoirs of the American Academy of Arts and Sciences. Boston.
Mém. Ac. Caen.	Mémoires de l'Académie Royale des Sciences, Arts, et Belles-lettres. Caen.
Mém. Ac. Dij.	Mémoires de l'Académie des Sciences, Arts, et Belles-lettres. Dijon.
Mem. Ac. Mad.	Memorias de la Real Academia de Ciencias Fisicas y Naturaes de Madrid. Madrid.

Mém. Ac. Rouen.	Mémoires de l'Académie de Rouen. Rouen.
Mem. Bost. Soc.	Memoirs of the Boston Society of Natural History. Boston
Mém. Soc. Bord.	Mémoires de la Société des Sciences physiques et naturelles de Bordeaux. Bordeaux.
Mém. Soc. Cherb.	Mémoires de la Société des Sciences Naturelles. Cherbourg.
Mém. Soc. Lille.	Mémoires de la Société Royale des Sciences, de l'Agriculture et des Arts. Lille.
Mém. Soc. Seine.	Mémoires de la Société des Sciences Naturelles de Seine et Oise. Versailles.
Nat. Tijds. Ned.-Ind.	Naturkundig Tijdschrift voor Nederlandsch-Indië. Batavia.
N. Z. Inst.	Transactions and Proceedings of the New Zealand Institute. Wellington.
Nouv. Mém. Mosc.	Nouveaux Mémoires de la Société Impériale des Naturalistes de Moscow. Moscow.
Proc. As. Soc. Beng.	Proceedings of the Asiatic Society of Bengal. Calcutta.
Proc. Can. Inst.	Proceedings of the Canadian Institute. Toronto.
Proc. Col. Soc.	Proceedings of the Colorado Scientific Society. Colorado.
Proc. Linn. Soc. N. S. W.	Proceedings of the Linnean Society of New South Wales. Sydney.
Rev. Cienc. Mad.	Revista de los Progres de los Ciencias exactas fisicas y naturaes de Madrid. Madrid.
Rev. Sci.	Revue Scientifique. Paris.
R. Soc. Can.	Proceedings and Transactions of the Royal Society of Canada. Montreal.
R. Soc. N. S. Wales.	Journal and Proceedings of the Royal Society of New South Wales. Sydney.
R. Soc. Vict.	Transactions and Proceedings of the Royal Society of Victoria. Melbourne.
S. Sci. Rec.	The Southern Science Record. Melbourne.
Tijds. Ind.	Tijdschrift voor Indische Taal-, Land- en Volkens-kunde. Batavia.
Trans. Ac. Conn.	Transactions of the Connecticut Academy of Arts and Sciences. New Haven.
Trans. Ac. St. L.	The Transactions of the Academy of Science of St. Louis. St. Louis.
Trans. R. Soc. S. Aust.	Transactions of the Royal Society of S. Australia. Adelaide.
Zts. Ferd.	Zeitschrift des Ferdinandeums für Tirol und Vorarlberg. Innsbruck.

Art.	Artificial.
Mon.	Monograph.
Pseud.	Pseudomorph.

Abstracts.

F. Genth and G. vom Rath (*Zeits. f. Krystallographie und Mineralogie*, X. p. 458) describe certain Vanadates and Silver Iodide from Lake Valley, Donna Anna County, New Mexico.

The minerals described are (1) Vanadinite. (2) A new mineral occurring in small yellowish-white hexagonal prisms, and having the composition $Pb_5\ Cl\ (AsO_4)_3 + Pb_5\ Cl\ (VO_4)_3$. It has only been found in very small quantities; the name *Endlichite* is here given to the mineral. (3) Descloizite occurs in small red or black crystals, which sometimes attain a length of 6 mm., associated with Pyrolusite, Psilomelane, &c. Their composition is expressed by the formula $- Pb_2\ [HO]\ VO_4 + Zn_2\ [HO]\ VO_4$, where Zn is partly replaced by Mn, Cu, Fe, and V to a slight extent by As and P. No traces were found of the new element Idunium, discovered by Prof. Websky in the Vanadates from Lake Valley. There is a notable difference between the Argentine Descloizite and that from Lake Valley, for while the former contains only 2·54 per cent. of zinc oxide, the latter contains 17·41 per cent. The Argentine crystals were found by Des Cloizeaux to be rhombic, but Websky suggested that they might be oblique and twinned; the crystals from New Mexico are here shown to be rhombic, a conclusion in which Websky now concurs. Confirmatory evidence is supplied by an optical examination undertaken by Des Cloizeaux. (4) Silver Iodide occurs in small and imperfect yellow crystals; one specimen showed indications of a twin structure hitherto unobserved on this mineral, the plane of twinning being parallel to $\frac{3}{4}\ P = \{10 . 1 . 1\}$.

G. vom Rath (p. 475 of the same Journal) gives a crystallographic description of the quartz from Burke Co., N. Carolina, of which the mode of occurrence is similar to that from Alexander Co. (v. *Min. Mag.* VI. p. 146). An attempt is here made to utilise the triangular markings so common on the pyramid faces as a means of determining whether the crystals are right- or left-handed, simple or twinned. The author finds that they have two unequal sides parallel to the pyramid edges; of these the greater is always nearer to the corner on which the face $s\ \{41\bar{2}\}$ appears or might be expected to appear. The markings on + R $\{100\}$ have sharp outlines and are bounded by smooth surfaces, those on − R, $\{22\bar{1}\}$ have their shortest side convex and formed of a rounded surface.

The character and positions of these markings on any part of a face will therefore show whether they belong to + R or to − R, and whether to a right- or a left-handed crystal.

Among the crystals described, one is noteworthy as exhibiting twin lamellæ parallel to a face of + R, and as having one of its ends right-handed while the other is left-handed.

Several new faces are described besides the rare forms P2, $\{5\bar{2}1\}$, $-\frac{3}{2}P\frac{3}{2}$, $\{21\bar{1}\}$, $\frac{4}{3}P\frac{4}{3}$, $\{10 . 1 . \bar{2}\}$, which all appear well developed.

Method of determining Opaque Minerals by the Microscope.—M. A. Inostranzeff (*Comptes Rendus*, Vol. c. 1885, p. 1396) describes an apparatus to which he gives the name of *Comparison Chamber*, and which renders it possible to identify opaque minerals in rocks. For this purpose two microscopes are used: in one is placed the rock section containing the mineral to be determined, in the other can be placed standard examples of known minerals; both of these are brilliantly illuminated from above.

The microscopes are without eye-pieces, and upon them is fixed the comparison chamber; this is a horizontal tube through which the rays that emerge from the microscopes are deflected by means of prisms at the two ends of the tube; at the centre are two prisms which project these rays upwards into an eye-piece fixed above the chamber in such a way that a circular field of view is obtained, of which one half belongs to one microscope and half to the other; the field will only appear uniform when the two minerals are absolutely identical in lustre and colour. The author reserves for a later paper further details concerning the scale of minerals used for comparison, and the method of illumination.

The Thinolite of Lake Lahontan.—The 12th Bulletin of the United States Geological Survey is a crystallographic study of thinolite by Prof. E. S. Dana (Washington, 1884). The calcareous tufas of the Lahontan basin were described under this name by C. King, in the Geological Exploration of the 40th parallel (Vol. I. p. 488). They form a crystalline deposit consisting of carbonate of lime, obviously pseudomorphous after some mineral which was thrown down in enormous quantities at some period in the history of this basin. The very imperfect skeleton crystals of thinolite have hitherto been supposed, in accordance with King's suggestion, to be pseudomorphs after Gaylussite, but a careful microscopic examination has convinced Prof. Dana that the original form was a tetragonal pyramid, having a terminal angle of $95\frac{1}{4}°$. This leads to the suggestion that the original mineral may have been a chloro-carbonate of lime isomorphous with phosgenite, *i.e.* having the formula $Ca\,CO_3 : Ca\,Cl_2$. Prof. Dana is also of opinion that the Gaylussite pseudomorphs of Sangerhausen and other localities ("the barleycorn" pseudomorphs) are also in reality pseudomorphs of calcite after the same mineral as that which formed the original material of the thinolite.

Russian Central Asia, including Kuldja, Bokhara, Merv. By Henry Lansdell, D.D. (Sampson, Low & Co., London, 1885).—In these two volumes Dr. Lansdell, in addition to the record of an adventurous journey, pleasantly told, gives much information as to the natural history and geology of this little-known region. He does not confine himself to what may have come under his own observation during his journey, but has brought together much information from the writings of Russian men of science, which gives his work an exceptional value.

Turkestan contains, we learn, in workable amounts, the following metals and rocks:—Gold, silver, lead, copper, iron, manganese, arsenic, turquoise, agalmatolite, graphite, mineral oil, petroleum, mineral and lake salt, native sulphur, sal ammoniac, alum, copperas, iron pyrites, porphyry, gypsum, and marble.

Besides limestone, gypsum and clay, some 6,500 tons of oil are obtained annually, of which three-fourths come from the Kuldja region and the remainder from the Syr-daria Territory. The Kuldja district likewise produces about 5,000 tons of coal a year, and that of the Syr-daria about 1,600 tons more; but of the other useful minerals most are unworked, in several instances it is doubted whether the amount is sufficient to render working, on any extensive scale, remunerative. The gold is found in alluvial deposits in minute nuggets or "dust," and the deposits are not rich. Some of the galena is argentiferous, but the ordinary ores of silver are not found. Turquoise is supplied by one deposit only, in Mount Karamazar, in a decomposed "felspar porphyry" cut by veins of diabase. Petroleum is obtained only in Ferghana, from a fossiliferous sandy limestone of cretaceous age. Altogether the mineral resources of the region traversed by Dr. Lansdell do not seem great in comparison with its extent.

L. J. Igelström has analysed (*Bull. Soc. Min. de France*, Tome VIII. p. 421) some pure crystals of Braunite from Jacobsberg, Wermland, Sweden; the results of five analyses according with those of the mineral from Elgersburg, Thuringia. Two determinations of the silica gave 8·09 and 9·25 per cent., thus corresponding with the analyses already made, with the exception of that by Turner, which the author believes to be inaccurate. The silica is not mechanically mixed, as it is supposed to be by some mineralogists, as the strongest magnifying powers failed to detect any impurity in the crystals analysed; it is doubtless an essential constituent. The author believes that the manganese is present as MnO_2 and not as Mn_2O_3, and suggests that the true formula should be that given by Dana, viz. $2\,(2\,MnO\,MnO_2) + MnO_2\,SiO_2$.

M. A. Lacroix has examined, by means of the microscope, the minerals to which the names of Harringtonite, Bowlingite, Kirwanite and Hullite have been given (*Bull. Soc. Min. de France*, Tome VIII. pp. 96, 97, 428). The Harringtonite examined was a piece given by Thomson himself (who analysed and named it) to Des Cloizeaux. It is not a homogeneous substance. With polarised light it proved to be an isotropic mass enclosing crystals belonging to two distinct species of zeolite, having different optical properties, probably natrolite and mesolite. Bowlingite consists of a green fibrous mineral, ortho-rhombic or oblique in crystallisation, enclosed in a magma of a serpentinous substance which is entirely isotropic. This substance also occurs as inclusions in the fibres. Kirwanite consists of a fibrous green substance, the optical properties of which approach those of the hornblendes. Lacroix points out that it is always surrounded by a pale yellow aureola, which consists of granular quartz and epidote. H. Fischer of Freiburg had earlier (1871) noted that some Kirwanite was mixed with a felspathic mineral. Hullite, like the preceding, is a mixture. A thin section shows that the mass is isotropic and contains inclusions of magnetite, calcite, and fragments of felspar. The author is of opinion that these substances cannot be regarded as distinct species.

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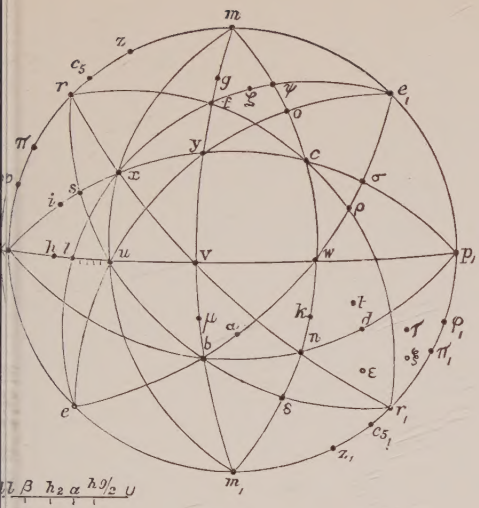
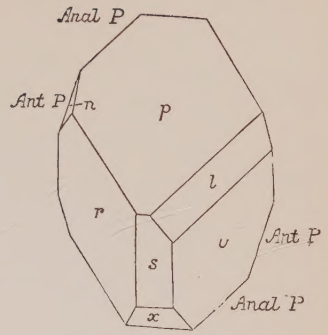


FIG. 1.



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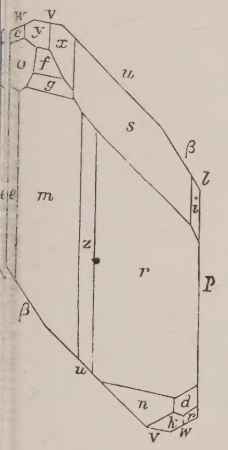

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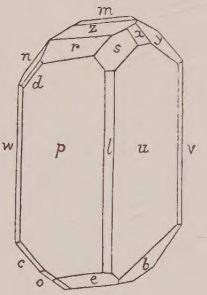

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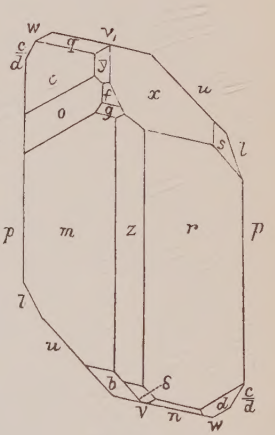
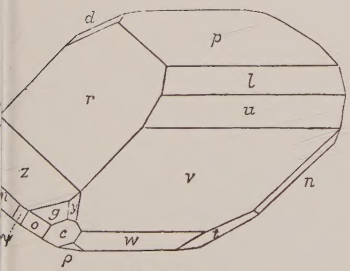


FIG. 3.



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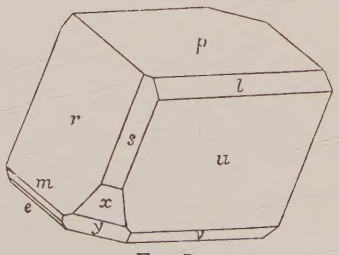

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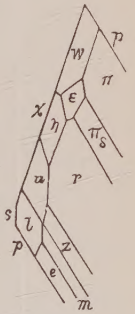

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	Chemical News	Boy Court, Ludgate Hill, E.C.
	Chemical Society	Burlington House.
	Colliery Guardian	49 Essex Street, W.C.
	English Mechanic	332 Strand, W.C.
	Geological Magazine	Trübner & Co., 57 Ludgate Hill, E.C.
	Geological Society	Burlington House
	The Keeper of Mining Records	28 Jermyn Street, S.W.
	Mining Journal	26 Fleet Street, E.C.
	Monthly Journal of Science.	3 Horseshoe Court, Ludgate Hill, E.C.
	Museum of Practical Geology	28 Jermyn Street, S.W.
	Nature	29 & 30 Bedford Street, W.C.
	Royal Microscopical Society	King's College, Strand, W.C.
	Royal Society	Burlington House.
Leeds.	Yorkshire Naturalists' Union	W. D. Roebuck, Sunny Bank.
	Leeds Naturalists' Club ..	11 Lilian Street, Burley, near Leeds.
Newcastle-upon-Tyne.	North of England Institute of Mining Engineers.	

EUROPE.

Helsingfors.	Administration des Mines.
Liége.	Société Géologique de Belgique.
Luxembourg.	Société des Sciences.
Paris.	Société Minéralogique de France.
Pisa.	Società Toscana di Scienze Naturali.
Rome.	Ufficio Geologico, S. Susanna.
Bonn.	Zeitschrift für Krystallographie und Mineralogie, Dr. C. Hintze, Lennestrasse 37.
Vienna.	K. K. Geologische Reichsanstalt.
	Mineralogische und Petrologische Mittheilungen.

AMERICA.

Baltimore, Maryland.	The Johns Hopkins University (Publication Agency).
Buenos Ayres.	Sociedad Cientifica Argentina.
New Brunswick.	Department of Mines, Nova Scotia.
Newhaven (Conn.)	American Journal of Science and Art.
Philadelphia.	Academy of Sciences.
Washington.	Smithsonian Institution (Agent, Wesley & Co., 28 Essex Street, W.C.)
	U.S. Geological Survey, Department of Interior.

AUSTRALASIA.

Sydney.	Technological Museum.
	Royal Society of New South Wales.
Wellington, N.Z.	New Zealand Institute.

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